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A Systematic Review: The Impact of School-Based Cooking Classes on Food Literacy and Healthy Habits

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ABSTRACT

Making better food decisions and having the confidence to create proper meals is crucial to bettering the health of children; however, in 2024, 1 in 5 children are considered obese, and about 25% of children aged 2-5 are considered obese in the United States. Cooking lessons have the potential to improve diet quality through teaching food literacy and reducing obesity in childhood, both of which are associated with improved mental health in adulthood. The aim of this systematic review is to investigate the impact of school-based experiential cooking classes on cooking skills, food literacy, and vegetable intake of children. A systematic review of PubMed, Scopus, and ScienceDirect was conducted for studies that compared the outcomes of children receiving cooking classes to a control group. Interventions included food preparation or cooking activities and took place on school premises. This systematic review includes 12 articles. Analysis showed a significant improvement in self-efficacy between the intervention and control groups of each study. In general, food knowledge also increased in most studies, although the extent to which it increased differed. Because of the varying results from each study, there was a small effect on vegetable intake in the intervention groups. Children's cooking programs result in noticeable improvements in cooking efficacy but small ones in vegetable intake. It is recommended that more interventions be conducted in the future to test the effectiveness of cooking classes. Future interventions should also use more consistent measurements of children's cooking confidence and healthy eating habits.

Introduction

Globally, nearly 15% of young people ages 10-19 experience a mental health disorder, which accounts for 13% of the types of diseases that children face in this age group. In 2016, almost 20% of children in the United States ages 2-8 years had a diagnosed mental, behavioral, or developmental disorder. In 2018-2019, around 15% of children ages 12-17 years had a major depressive episode with 37% having persistent feelings of sadness or hopelessness (Rockville, 2022). Furthermore, according to the Centers for Disease Control and Prevention (CDC), there is also a correlation between gender and mental health among children. An estimated 9.0% of boys were reported to have taken medication for their mental health compared with 7.3% of girls. In 2021, boys were as likely as girls to have received any mental health treatment in the past 12 months (Zablotsky & Ng, 2023).

According to a study about the associations between being overweight, obesity, and mental health, individuals who have mental illnesses show a 2- to 3-fold increased risk of obesity. The study also stated that people living with obesity are at a 30 to 70% higher risk of developing a mental illness (De Hert et al., 2011). Furthermore, a North American study found that about 80% of 10,000 people diagnosed with schizophrenia, bipolar disorder or depression were either affected by being overweight or lived with obesity (Correll et al., 2010). In children, a report on the fifth round of data collection, 2018–2020: WHO European Childhood Obesity

Surveillance Initiative (COSI) indicated that 29% of children aged 7–9 years were living overweight (including obesity) from the data collection 2018–2020 (World Health Organization, 2022a). National data from the National Child Measurement Programme further shows that the prevalence of children living with obesity more than doubles from children at the start of primary school to the end of primary school in the UK (NHS Digital, 2022). Therefore, there is an urgent need for interventions that prevent the increase in obesity which can then increase the chances of mental health issues in children.

The implementation of nutritional programs and home economy courses in school can be paramount to combat the rise in obesity and thus the multitude of mental and physical health issues that can come with obesity. Previous reviews have shown a link between children's nutrition education programs in primary schools and improved food literacy, self-efficacy, and dietary intake for children. The studies reviewed in this paper show a link between cooking confidence, food literacy, and dietary intake through a systematic review and meta-analysis of the available literature on participatory cooking classes. Cooking and home economy classes can play a crucial role in improving food literacy and diet quality among the young participants in each intervention. Results indicated that cooking programs increased vegetable intake, cooking confidence, and food literacy. It is then hoped that further interventions are studied to increase evidence about the impacts of experiential cooking programs on children.

Methods

A systematic review was selected for the methodology of this review. Databases such as PubMed, Scopus, and ScienceDirect were made based on their reliability and recognition, as well as the specific content of each database in terms of research in the field of education. After the search and selection of relevant articles to the question, an analysis process was carried out by extracting relevant information about the studies and their findings (author, title, purpose, number of participants, methods, results), from which the evidence of the results obtained was contrasted with similar literature.

Using the PubMed, Scopus, and ScienceDirect databases, a search for bibliographic documents was carried out between the months of April and May 2024 using a combination of the following descriptors: Key terms searched when looking for research included 1) 'cooking' or 'food literacy' 2) 'adolescents' or 'elementary school'. The results of the initial search were limited to full documents, open-access documents, categories restricted to "education/educational research", and documents written in English. At this initial stage, the search resulted in 50 articles. Before screening the articles further, duplicate records were eliminated and articles were further eliminated due to other reasons. This led the number of articles before screening to 47 studies. Using the selection criteria in Table 1 additional papers were excluded therefore resulting in a total of 12 sources in the end. Figure 1 depicts the process of study selection.

Table 1. Selection Criteria

	Inclusion Criteria	**Exclusion Criteria**
A	Research in English published in scientific journals	All other publications (books, or not related to educational aspects)
B	Categories restricted to research about adolescents or elementary school students	Studies related to other categories not included in the objectives of this study

C	Categories restricted to research about cooking/experiential cooking programs happening during school hours	Studies or experiences utilizing other programs unrelated to cooking or nutrition
D	Specific studies about cooking skills, cooking self-efficacy, food literacy, mental health, and overall well-being of children	Studies unrelated to the objectives and outcomes of this study

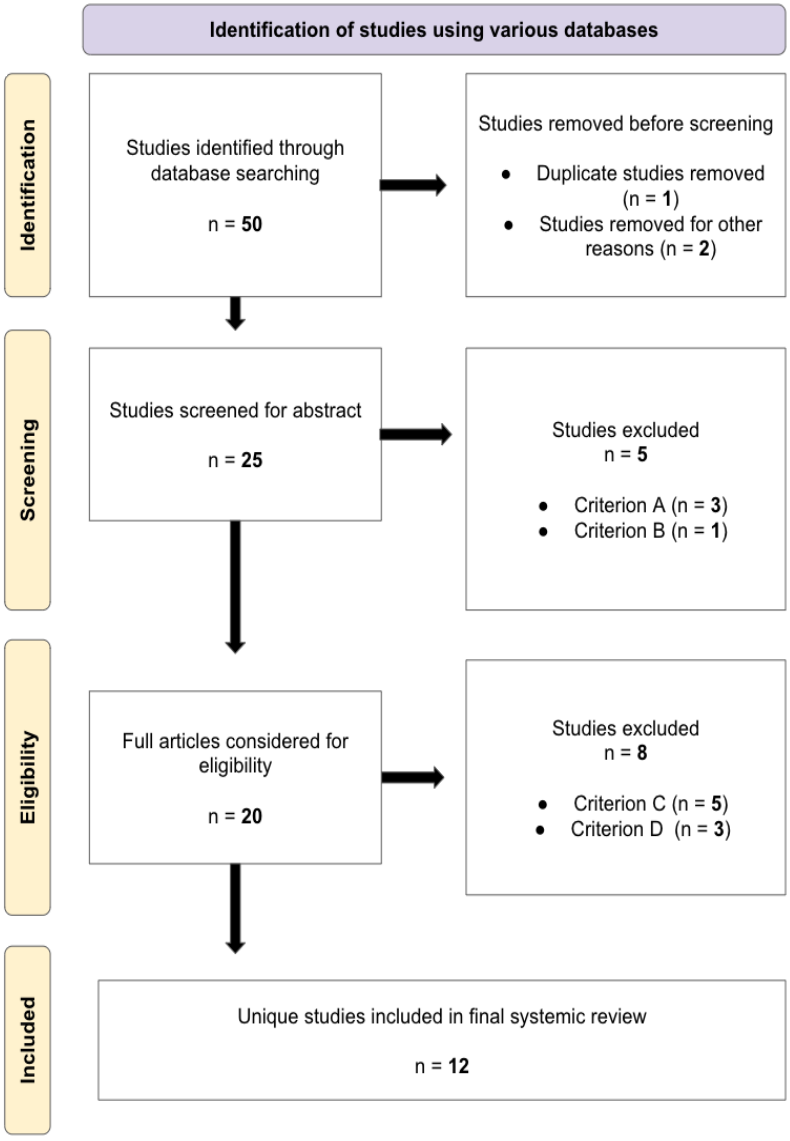

Figure 1. Methodology of Studies Identified for Systematic Review

Results

Study Characteristics

The articles presented in this section report different studies focused on the impact of cooking interventions in the educational field. Table 2 lists the main highlights of the documents obtained, indicating the purpose, number of participants, methods, and results of each study. All studies focused on a specific program and assessed the impact of each intervention on children. Studies one, four, five, and twelve all focus on self-efficacy in children who participated in cooking programs. Studies two and eight focus on the health of life and obesity levels among children taking each course. All other studies focus on children's openness to new foods such as vegetables after participating in each intervention.

Table 2. Results of Systematic Review

Study Name	Purpose	Number	Methods	Results
Effectiveness of a School-Based Culinary Programme on 9- and 10-Year-Old Children's Food Literacy and Vegetable, Fruit, and Breakfast Consumption	To assess whether a school based culinary program could improve food literacy between boys and girls. The study also aimed to strengthen the existing evidence related to the role that culinary programs play in improving students' food literacy and eating habits	170	Cluster quasi-experimental study; self-administered online questionnaire; Likert scale; Multivariate analysis of variance (MANOVA); SPSS	Cooking skills and food knowledge of children from grades 4 to 5 can be improved after participating in the culinary program. Boys will benefit significantly more than girls. The program was ineffective at increasing vegetable and fruit consumption as well as the odds of eating breakfast regularly
Effectiveness of a childhood obesity prevention programme delivered through schools, targeting 6 and 7 year olds: cluster randomised controlled trial (WAVES study)	To assess the effectiveness of a school and family based healthy lifestyle programme (WAVES intervention) compared with usual practice, in preventing childhood obesity.	200 schools	Cluster randomized, controlled trial; WAVES study intervention; questionnaires; blocked balancing algorithm; Poisson mixed regression	There was no overall evidence in the improvement in the primary outcomes of reduction in body mass index. There were no effects on the secondary outcomes either. However, from data available 39 months after the study, there was a clinically significant different in BMI score
The Cookshop Program: Outcome Evaluation of a Nutrition Education Program Linking Lunchroom Food Experiences with Classroom Cooking Experiences	To examine the feasibility and effectiveness of a nutrition education intervention for elementary school children, grades K-6, called the Cookshop Program.	590	Pilot tests; pencil-and-paper outcome evaluation questionnaire; 4-point Likert-type scale; 2 x 2 analysis of covariance;	Increasing exposure to foods in children leads to increased preferences. The experience of having fun with food and enjoying eating what they have created all positively correlate to this idea. Cooking classes can also have an effect on self-efficacy in children (especially among the older children)
Cooking Matters for Kids Improves Attitudes and Self- Efficacy Related to Healthy Eating and Cooking	To assess changes in self-efficacy and attitudes related to healthy eating and cooking in Cooking Matters for Kids participants.	18,113	Presurvey and postsurvey; cognitive interviews; mixed models; logistic regression; G*Power;	Children participating in Cooking Matters for Kids improved attitudes towards healthy foods and self efficacy for healthy eating. Since there was a high level of self efficacy and attitudes reported at baseline, there was only a minimal increase in effect sizes in the main analyses. However, the results of the subgroup analyses did show the practical significance of children starting off with lower baselines
Yes I can cook a fish; effects of a five week sensory-based experiential theme course with fish on 11- to 13- year old children's food literacy and fish eating behaviour – A quasi-experimental study	Investigate the effect of a five week sensory-based experiential theme course with fish on 11- to 13-year old early-phased adolescents' food literacy and acceptance of fish.	383	Low structured participant observation; telephone and group interviews; semi-structured survey questionnaire; Applied Thematic Analysis (ATA); SPSS Statistics version 26; Mann-Whitney U test	Participant observation revealed that the program helped in children's ability to work with others and have their own autonomy. Knowledge increased and the intervention effect on skills was high. In addition, the study found that girls' skills in particular were positively affected by participation in the theme course while the boys' skills would be negatively influenced.
Healthy Helpers: Using culinary lessons to improve children's culinary literacy and self-efficacy to cook.	To investigate the impact of a culinary literacy (CL) curriculum on children's acceptance of vegetable-added (mushrooms) recipes, CL, self-efficacy to cook (SE), and willingness to try vegetables (WV).	39	Culinary Literacy Survey (CLS); quantitative survey; quasi-experimental, pre-post survey design; post hoc power analysis; paired t-tests	Measures of children's acceptance of recipes should feature a mixed method model with testing that allows researchers to examine sensory attributes that were liked and disliked by children. The short-term changes elicited by the Healthy Helpers program (i.e., increased acceptance of food with an added vegetable, increased CL and increased culinary SE) may lead to longer-term behavior changes necessary for increased vegetable intakes

Cook like a boss online: An adapted intervention during the COVID-19 pandemic that effectively improved children's perceived cooking competence, movement competence and Wellbeing - International Journal of Behavioral Nutrition and physical activity.	Aimed to assess the effectiveness of an adapted virtual theory-based cooking intervention on perceived cooking competence, perceived movement competence and wellbeing	248	CooC11; survey; The Stirling Children's Well-being Scale; IBM SPSS Version 26; Durbin-Watson test	There is a relationship between perceived movement competence, cooking competence, and wellbeing when it comes to cooking programs. The research displays that there is potential for cooking to be used as a mechanism for targeting improvements in wider aspects of lifestyle such as movement and wellbeing
Food environment intervention improves food knowledge, wellbeing and dietary habits in primary school children: Project Daire, a randomised-controlled, Factorial Design Cluster Trial - International Journal of Behavioral Nutrition and physical activity.	Account for the outcomes of Project Daire which is a program aimed at improving children's health-related quality of life, wellbeing, food knowledge and dietary habits through two multicomponent interventions	903	Randomised-controlled, factorial design four-arm trial; STATA; online survey; hard copy questionnaires; Strengths and Difficulties Questionnaire; KIDSCREEN-10	Intervention that aimed to alter food environment in the current study led to an improvement in emotional and behavioral well-being in these pupils post-intervention, compared with pupils who did not receive the 'Nourish' intervention. Modifying the whole school food environment has a positive effect on children's well-being, knowledge about food and intake in those most at need within economically deprived regions
Improving the metabolic and mental health of children with obesity: A school-based nutrition education and Physical Activity Intervention in Wuhan, China.	To evaluate the effectiveness of a school-based nutrition education and physical activity intervention on cardiovascular risk profile and mental health outcomes among Chinese children with obesity.	171	Anthropometric parameters and blood pressure measurement; fasting blood test; Mann–Whitney U test; Wilcoxon signed-rank test; McNemar's test; Gamma GEE with log link	Although the nutrition education intervention did not significantly decrease BMI in the intervention group compared to the control group, there were effective reductions in poor well-being and social anxiety. Similarly, there was a decreased risk of depression (albeit insignificant)
How a 7-week food literacy cooking program affects cooking confidence and Mental Health: Findings of a quasi-experimental controlled intervention trial.	To explore the efficacy of a 7-week cooking program in improving cooking confidence, whether this transferred to behavior surrounding food, and/or affected mental health	657	Quasi-experimental controlled study; JMOF participant questionnaire; SF-12 Health Survey; Subjective Vitality Scale (SVS); Warwick Edinburgh Mental wellbeing Scale (WEMBWS); IBM SPSS Statistics for Windows, version 25.0	This study found that all five components of cooking confidence increased for participants in the intervention group compared to the control group. For the best results of intervention programs, individuals should actively participate in the experience. Evidence suggests that increased self-efficacy can have a positive influence over dietary habits regarding cooking meals from basic ingredients
An Experiential Cooking and Nutrition Education Program Increases Cooking Self-Efficacy and Vegetable Consumption in Children in Grades 3–8	To evaluate the effect of a community-based, experiential cooking and nutrition education program on the consumption of fruits and vegetables and associated intermediate outcomes in students from low-income families	271	Quasi-experimental pre–post survey design;	The experiential cooking program used in the report improved both cooking self-efficacy, liking, and consumption of vegetables. The program also demonstrated the influence of home eating and cooking practices. Over time, the combination of increased preference, cooking skills, and involvement of family routine in-home meal practices could help reduce the risk of chronic disease and improve the overall health of children
Impact of a school-based cooking programme on home cooking participation in Japan	To assess the impact of the cooking programme on children's participation in cooking at home and their self-efficacy and attitudes towards cooking.	170	Quasi-experimental study; pre- and post-programme surveys; $\chi 2$ tests; Wilcoxon signed-rank tests; IBM SPSS Statistics 19.0	The number of children who cooked at home significantly increased in the group that took the cooking class before and after the programme. Self-efficacy towards peeling apples significantly increased in the group who took the cooking class but did not increase in the group without the class.

Description of the Interventions and Cooking Programs

The studies included in the review included varying numbers of participants, with some studies having a smaller sample size of around 44 families and others having a sample size of 200 schools.

Interventions on Food Literacy

Other studies such as that of Policastro et al. (2023) examine the effect of a school-based cooking program that featured at-home cooking experiences on children's acceptance of certain recipes and willingness to try new foods without direct nutrition education. The study aims to add to the already existing research about the best practices to encourage children from lower-income families to eat more vegetables while improving nutrition behaviors. The study also tried to build off of previous research about the best ways to improve culinary knowledge and self-confidence/self-efficacy in the life skill of cooking. The Culinary literacy survey (CLS) was administered to gain results about the effects of the program. Results from the study displayed how children participating in the cooking program had improved outcome measures that may predict improved vegetable intake. Participating in the curriculum improved nutritional behavior drivers such as culinary self-efficacy and culinary literacy knowledge. However, no observed increased measures in willingness to eat vegetables. There were significant statistical differences between the means of pre- and post-CLS scores for each sub-category which included self-efficacy to cook, cooking literacy knowledge, and willingness to eat vegetables. The paired t-tests conducted in the study, revealed a significant increase in children's pre-post self-efficacy [$t(38) = -16.064$, $p < 0.001$] and total scores [$t(38) = -8.088$, $p < 0.001$].

Labbe et al. (2023) allow us to assess whether a school-based culinary program could improve food literacy between boys and girls. The study also helps us strengthen the existing evidence related to the role that culinary programs play in improving students' food literacy and eating habits. Students in the experimental group had, on average, an 11.0 greater point increase in cooking skills and a 0.94 greater point increase in food knowledge compared to students in the control group. The study also found that gender, age, socioeconomic status, and ethnicity all played a role in the results of the experiment. Boys in the experimental group had, on average, a 12.04 greater point increase in cooking skills and a 1.45 greater point increase in their food knowledge than boys in the control group.

Other studies such as that of Liquori et al. (2008) aimed to answer the question: Is cooking in the classroom a more effective strategy than other forms of active participation? Outcomes were presented from an evaluation of the effectiveness of CS (where cooking was the centerpiece of the intervention) and FEL (food and environmental lessons). The results of this study display that classes that received CS had higher mean food preference scores than classes that did not receive it. The studies show that both CS and FEl both had a positive effect on knowledge. In younger classes, both CS and FEL had similar impacts but in the older classes, CS had a much greater impact. In terms of self-efficacy, CS had a positive impact while FEL had no impact. As for the behavioral intentions of students, for the younger classes that received CS, behavioral intention scores were higher than classes that did not receive CS. Overall, the results point to the fact that the CS approach was able to improve the intake of targeted foods by increasing exposure to foods in children. The experience of having fun with food and enjoying eating what they have created all positively correlates to this idea.

Højer et al. (2021) aim to investigate the effect of a five-week sensory-based experiential theme course with fish on 11- to 13-year-old early-phased adolescents' food literacy and acceptance of fish. Students were split up into an experimental group ((MG) 5-week theme course on fish) and two independent control groups (CG1) one with no intervention and (CG2) one with an oral lecture). The results show that girls in MG had a higher mean effect than girls in CG while boys in MG had a lower and negative mean effect score than boys in CG. Girls in general were more positively affected by participating in the theme course than boys. However, boys were more positively affected in the CG. Although perceived disgust increased in children participating in the MG compared to the CG, children were much more likely to become curious about tasting other types of fish. For example, when the MG group was asked whether they had become curious about tasting other types of fish after participating in the theme course, 47% agreed or strongly agreed with the statement. Furthermore,

38% either agreed or strongly agreed with the statement 'after the theme course I like fish better than I did before'. Also, even if the children were not sure how to correctly filet a fish, they did not want actual help, just an acknowledgement that they were not doing anything wrong.

Other studies such as that of Jarpe-Ratner et al. (2012) assessed the effectiveness of a cooking program on a group of low-income families. The study was also aimed at observing whether the programs could also increase children's liking for fruits and vegetables, cooking at home, and communication from the child to the family about healthy eating. There was an increase in the score for vegetable and fruit consumption in the students who took the course by about 0.2. There was also an increase in the mean score of nutrition knowledge, exposure to foods, as well as self-efficacy scores and the frequency of student cooking at home. Participation in the cooking education program increased students' cooking self-efficacy score by 0.4. However, the program did not affect the liking for fruits and vegetables or the consumption of unhealthy foods like chips and soda. Furthermore, parents reported that their child's participation in the cooking program significantly increased family conversation about healthy food, how often their child prepared dinner, and the importance parents place on the family meal.

Interventions on Self-Efficacy and Cooking Confidence

Soldavini et al. (2021) focus their research on assessing changes in self-efficacy and attitudes related to healthy eating and cooking in children who participated in Cooking Matter for Kids, a campaign that teaches children from low-income environments how to shop for and prepare healthy, low-cost meals. Results showed that a majority of students demonstrated improvements in self-efficacy with the mean score increasing from 34.4 to 36.2 ($P < 0.0001$). The study also illustrated significant improvements in the mean scores for each of the individual self-efficacy items ($P < 0.0001$), with 21.4% to 34.5% of children improving on each item. For example, 44% of children improved their attitudes about eating. In the subgroup where children had a lower baseline self-efficacy score, there was an overall increase in scores as well. It was observed that children participating in Cooking Matters for Kids improved attitudes toward healthy foods and self-efficacy for healthy eating. For example, there was a large effect size for overall self-efficacy, with > 80% of children improving. However, since there was a high level of self efficacy and attitudes reported at baseline, there was only a minimal increase in effect sizes in the main analyses.

Other studies such as that of Hollywood et al. (2022) aim to assess the effectiveness of a virtual theory-based cooking intervention on cooking competence, perceived movement competence, and well-being. Another aim of the study was to explore the relationships between these variables in relation to the intervention. Results of this study displayed how there was a significant positive correlation between perceived cooking competence and perceived movement competence as well as well being. Children's perceived cooking competence scores increased from 31.58 to 37.48 between the pre and post-intervention. Movement competence and well-being increased from pre to post-intervention with scores increasing from 37.98 to 39.48 and 46.64 to 47.42 respectively. The intervention had a small to medium effect on cooking competence, a small to medium effect on movement competence, and a small effect on well-being. The research overall displays that there is potential for cooking to be used as a mechanism for targeting improvements in wider aspects of lifestyle such as movement and well-being.

Rees et al. (2022) explored the impact of a community-based cooking program and whether it was successful in improving cooking confidence and ability. The study also hoped to see if that behavior could be transferred to behavior and attitudes surrounding food. Another aim was to determine whether the program would change attitudes, beliefs, and behaviors toward healthy cooking and associated general health and mental health costumes. Results illustrated that although there was a slight difference in the confidence between women and men in the first benchmark, both genders were equally confident in the second benchmark. Participants in the intervention group reported an increase in their enjoyment of cooking post-program that was sustained over 6 months and was not observed for the control group. For example, scores relating to attitudes and beliefs

regarding healthy eating increased from 2.52 to 2.80 in the intervention group. The overall confidence score for the intervention group increased from 17.82 to 21.34.

Other studies such as that of Yoshii et al. (2021) assessed the impact of the cooking program on children's participation in cooking at home and their self-efficacy and attitudes towards cooking. In the group that took the cooking class, the number of children who cooked at home significantly increased before and after the program. Self-efficacy towards peeling apples significantly increased in the group who took the cooking class but did not increase in the group without the class with the score increasing from 2.5 to 3.0. General self-efficacy also increased from 2.5 to 3.0 and cooking attitudes increased from 28.0 to 30.0. However, while cooking attitudes and self-efficacy in general were expected to improve, no significant differences were found. Overall, the number of children who responded that they 'almost never' cook at home decreased for the group that took the cooking class. Those who began cooking at home showed an increase in cooking attitudes and self-efficacy.

Interventions on Health-Related Quality of Life

Brennan et al. (2021) account for the outcomes of Project Daire which is a program aimed at improving children's health-related quality of life, wellbeing, food knowledge, and dietary habits through two multicomponent interventions. Schools in the Daire program were randomized into one of four 6 month intervention sub-sections: Nourish and Engage. Qualitative feedback received from teachers revealed that children were more open to trying new foods after the activities in the program. Those who were part of the Nourish program saw a significant decrease in Total Difficulties Score with scores going from 7.82 to 6.85 as well as the Conduct Problem Score with scores going from 1.15 to 1.02. There were no significant differences in scores between those who took part in the Engage intervention and those who did not. Furthermore, there were no significant Health-Related Quality of Life scores from the KIDSCREEN-10 questionnaire in both interventions.

Other studies such as that of Yu et al. (2020) evaluated the effects of nutrition education and physical activity intervention among Chinese school-aged children with obesity on BMI, cardiovascular risk profile, as well as mental health outcomes. Results show that there was a significant reduction in fasting blood glucose in the intervention group from baseline to post-intervention while the control group increased. However, there were no significant differences in the psychological factors between the two groups. It is important to note that after the intervention, the proportion of poor well-being in the intervention group decreased. Poor well-being decreased from 27 to 13, 27 to 16, and 30 to 20 between the pre and post-intervention groups of the experiment.

Adab et al. (2018) carried out a study that assessed the effectiveness of a school and family-based healthy lifestyle program (WAVES intervention) compared with usual practice, in preventing childhood obesity. Regarding the results obtained from this study, at 15 and 30 months after the start of the intervention, the BMI levels of students included in the study were non-significantly lower. In terms of diet, physical activity, and blood pressure, the energy expenditure and blood pressure were too inconsistent to be considered significant during both follow-ups included in the study. However, among Group 1 of school participants, the mean BMI score was lower after the intervention. There was no effect on quality of life, social acceptance, or body image during the trial. It is important to note that the intervention was generally well implemented, although no school delivered all components completely as intended. Just under half the schools achieved at least 75% of the maximum possible score and only five schools failed to achieve at least 65% of that maximum.

Effects on Cooking Self-Efficacy

A majority of studies talked about the effects of cooking on self-efficacy. In the study that evaluated the successfulness of Cooking Matters for Kids, used pre-survey and post-survey data to determine the effect on self-efficacy among the children participants of the program. Results displayed that even in the subgroup analyses

for children with lower baseline self-efficacy scores (< 32, n = 4,386), 81.4% improved their overall self-efficacy, with an increase in mean overall score from 26.4 to 32.6 (Soldavini et al., 2021). Another study that assessed self-efficacy through a culinary literacy (CL), utilized two validated surveys that were expert-reviewed called the PRAs and the Culinary Literacy Survey (CLS) to obtain data about the effects of the program. Using the pair t-tests, results displayed that there was a statistically significant increase in children's pre-post self-efficacy to cook [$t(38) = -16.064$, $p < 0.001$] and total scores [$t(38) = -8.088$, $p < 0.001$] (Policastro et al., 2023). A final study that tried to answer the question of if a 7-week food literacy cooking program could affect cooking confidence and mental health, utilized a participant questionnaire as well as an online self-report questionnaire to assess the results of the intervention. Results illustrated that numbers for sub-groups of confidence scores increased while the overall confidence score rose from 17.82 to 21.34 in the intervention group (Rees et al., 2022). Overall, self-efficacy increased in a majority of sources with some reporting significant increases in the mean scores for self-efficacy as well as cooking confidence in general.

Effects on Food Literacy

Each study presented in the review looked at food literacy in a different way. For example, one study that aimed to assess the effectiveness of a school-based culinary program on 9- and 10-year-old children's food literacy defined food literacy as children's vegetable and fruit consumption, cooking skills, food skills, and food knowledge. The results of this study displayed that vegetable and fruit consumption among both male and female participants in the experimental group rose from 5.50 to 6.14. In general, food knowledge also increased from 5.34 to 6.47 in the experimental group which once again shows the effectiveness of cooking programs on children's food-related decisions (Labbe et al., 2023). Another study that assessed food literacy by analyzing effects of a five-week sensory-based experiential theme course with fish on 11- to 13-year-old children's food literacy used children's acceptance of fish before and after the program. Results of this study illustrated that although the willingness of children to eat unknown foods decreased from 0.9 to 0.7 in the intervention group, children found fish less disgusting with the score decreasing from 0.6 to 0.3 (Højer et al. 2021).

Effects on Vegetable Intake

Researchers in each study came up with their results through methods like a cluster quasi-experimental study; a self-administered online questionnaire, the Likert scale, as well as multivariate analysis of variance (MANOVA). Many of the studies showed little to no increase in vegetable intake but there were some occurrences of positive correlations between vegetable intake and cooking programs. The Cookshop Program utilized a pencil-and-paper outcome evaluation questionnaire to examine their results. The results of this program illustrated that classes that received the cookshops had higher mean food preference scores (which include vegetables and whole grains) than classes that did not receive them. This was true for both younger classes (3.93 compared to 3.04) and older classes (3.34 compared to 3.16). However, there was no change in the attitudes towards these foods with the score remaining 3.35 (Liquori et al., 2008). Another study that evaluated dietary habits in children participating in a program called Project Daire used data collected via online surveys and hard-copy questionnaires. The results of this study displayed that at the endpoint of the study, those that participated in the Nourish and Engage program had fruit consumption scores of 231 and 242 respectively compared to the children who did not participate in either having scores of 205 and 194. Furthermore, vegetable intake followed a similar pattern with those who did not participate in the interventions having significantly lower scores than those who did (Brennan et al. 2021).

Discussion

The findings support the important role that cooking programs can have in improving the mental health and diet quality of children. Results indicated that cooking programs increased vegetable intake, cooking confidence, and food literacy, although the extent of this increase varied among studies. In the future, the promotion of cooking classes that focus on nutrition education and cooking skills, in general, should attempt to improve and expose children to the benefits of experiential cooking programs.

However, there are concerns about research in the field. For example, the variety of measures for each cooking program which made it hard to properly determine whether the cooking interventions were successful. One study in particular utilized a cluster quasi-experimental study to assess a program called Apprenti en Action (Labbe et al. 2023). Another study used a Wilcoxon signed-rank test (for BMI and metabolic parameters) and McNemar's test (for behaviors and mental health parameters) was applied to examine changes from baseline to post-intervention within the control and intervention groups (Yu et al., 2020). With that being said, many of the studies employed complex multi-component interventions where students would participate in an experiential class during school, have a lecture, or have some kind of aspect of the intervention at home. However, not all of the studies were like this which makes comparing results hard.

The duration of each study also may have played a big part in the effectiveness of each study but makes it hard to compare the effectiveness of cooking programs as a whole if they all involve a different time period. For example, the intervention that involved the WAVES study took place over 12 months and resulted in the mean BMI score being lower after the intervention and even lower months after the initial intervention (Adab et al. 2018). Another focused on a program that ran over the school break in April 2021. The results of this study showed that well-being scores in children who participated in the Cook Like A Boss program increased from 46.64 to 47.42 between the pre- and post-intervention (Hollywood et al., 2022). A final study was a 1-year evaluation of a community-based nutrition and cooking education program. The results of this study portrayed that participation in the cooking education program increased students' cooking self-efficacy score by 0.4 and the frequency of student cooking at home score by 0.1 (Jarpe-Ratner et al., 2012). While all studies yielded positive results, there is no way to tell which one was more successful due to the differing variables as well as time periods for each study.

Practical Implications

The research presented in this review shows a positive correlation between the overall well-being of children and cooking interventions implemented in school. However, effectiveness can also depend on factors such as how much children are exposed to food, the duration of each program, teacher and family intervention, gender, as well as age. It is important to note that there has been some hardship in implementing cooking programs in children mainly because of the idea that they are not worth spending time and money on. This may be because of the fact that cooking and the skills that come with it are not included in standardized testing. At the same time, there may be a lack of equipment for these interventions or safety issues with managing certain items in the classrooms which is a particular problem for this age group especially when resources are limited for this curriculum" (Vaughan et al., 2024).

However, the results portray how valuable it is to have experiential cooking classes implemented into the education program of children. Multiple studies display changes in attitudes towards cooking, an increase in cooking confidence scores as well as a significant difference in the cooking abilities between the control and intervention groups. More than that, multiple studies have pointed to the fact that cooking interventions are capable of increasing fruit and vegetable consumption despite the extent of this increase being small. This is

implemented in studies through increasing exposure to foods in children which then leads to increased preferences. The experience of having fun with food and enjoying eating what they have created all positively correlates to this idea.

In the future, there will be a need for more high-quality randomized controlled experiments in the school setting that seek to improve children's cooking skills and self-efficacy. At the same time, there needs to be a better way to assess the effectiveness of a variety of studies even if they might have different durations, methods, resources, and other factors that may yield results that are hard to compare. However, there are already tools that exist that can be used to solve these issues. For example, future studies can use the Tool for Food Literacy Assessment in Children (TFLAC) which contains numerical values for food systems knowledge, cooking skills, cooking knowledge, nutrition knowledge, and self-efficacy (Amin et al., 2019). Future studies also need to consider the risk of bias in each study. To solve the issue of bias in each study, the Risk of Bias Assessments can be used (Sterne et al., 2019).

Limitations and Strengths

The strengths of this review include the fact that it uses a systematic approach to identify relevant studies for the review as well as relatively broad inclusion criteria to gain an overview of published culinary nutrition interventions and experiments. The review is then capable of enabling for an understanding of outcomes with respect to the various perspectives and ways to approach a cooking intervention

However, this study's limitations include factors such as a low number of research cases being studied and inconsistency with the different studies. This can be addressed, though, through high-quality studies evaluating cooking interventions in schools, which can help to strengthen the evidence that these interventions are capable of producing a positive outcome among the children participating in them.

Risk of Bias

Bias and uncertainty were parts of each study with some having higher levels than others. One study discusses the idea that although the questionnaire used in this study was developed based on previously validated questionnaires, the psychometric properties of the final tool were not tested. In addition, the questionnaire was self-administered, which could have led to social desirability bias. Some other types of bias could have occurred from the duration of the study or children tending to overestimate their skills in cooking categories. Another study makes a note that its practices may have been limited by sampling bias due to the over-representation of those with pre-existing higher-than-average cooking confidence, greater interest in food and nutrition and motivation toward healthy cooking and eating. While each study may have differing reasons why bias is included, the main risk of bias in non-randomized studies is due to the measurement of outcomes. However, the bias relating to the measurement of outcomes could have been addressed through the randomization process.

Conclusion

While a small number of trials showed small positive effects for increased vegetable intake and increased cooking confidence, more high-quality randomized evaluations are needed to increase the certainty of evidence and the true impacts of cooking interventions. The findings of this systematic review suggest that the teaching of nutrition education as well as implementing a cooking program in the school environment can make an important contribution to the knowledge and dietary habits of children. Another finding also illustrates how gender and age can play a role in how effective cooking interventions are on children. Furthermore, the effects of each

cooking program indicate that policymakers need to be more open to implementing these kinds of programs in the school environment.

It is important to note, however, that not all cooking programs produce the same results. Future intervention research in this field would be beneficial if researchers implemented strategies that demonstrated higher effects in nutritional knowledge, increasing fruit and vegetable consumption, as well as correlations between self-efficacy and student performance in school. Specifically, future trials should consider detailing the behavior change techniques of each intervention so that more can be understood about what the best approach to a culinary intervention program is as well as the circumstances needed for complex multi-component interventions. As stated before, consistent use of outcome tools for vegetable intake, Food Literacy, and cooking competence will improve the consistency and precision of meta-analysis and therefore the certainty of evidence.

It is hoped that interventions that involve experiential cooking classes in primary schools will increase cooking skills and confidence and improve vegetable intake. Existing evidence does not indicate whether cooking interventions in primary schools improve cooking confidence, food literacy, or dietary habits. Reviews in this area may indicate a high risk of bias, while others may use an inadequate sample size. Therefore, it is even more important that there are more efforts to study culinary interventions and the impacts they have on young children.

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